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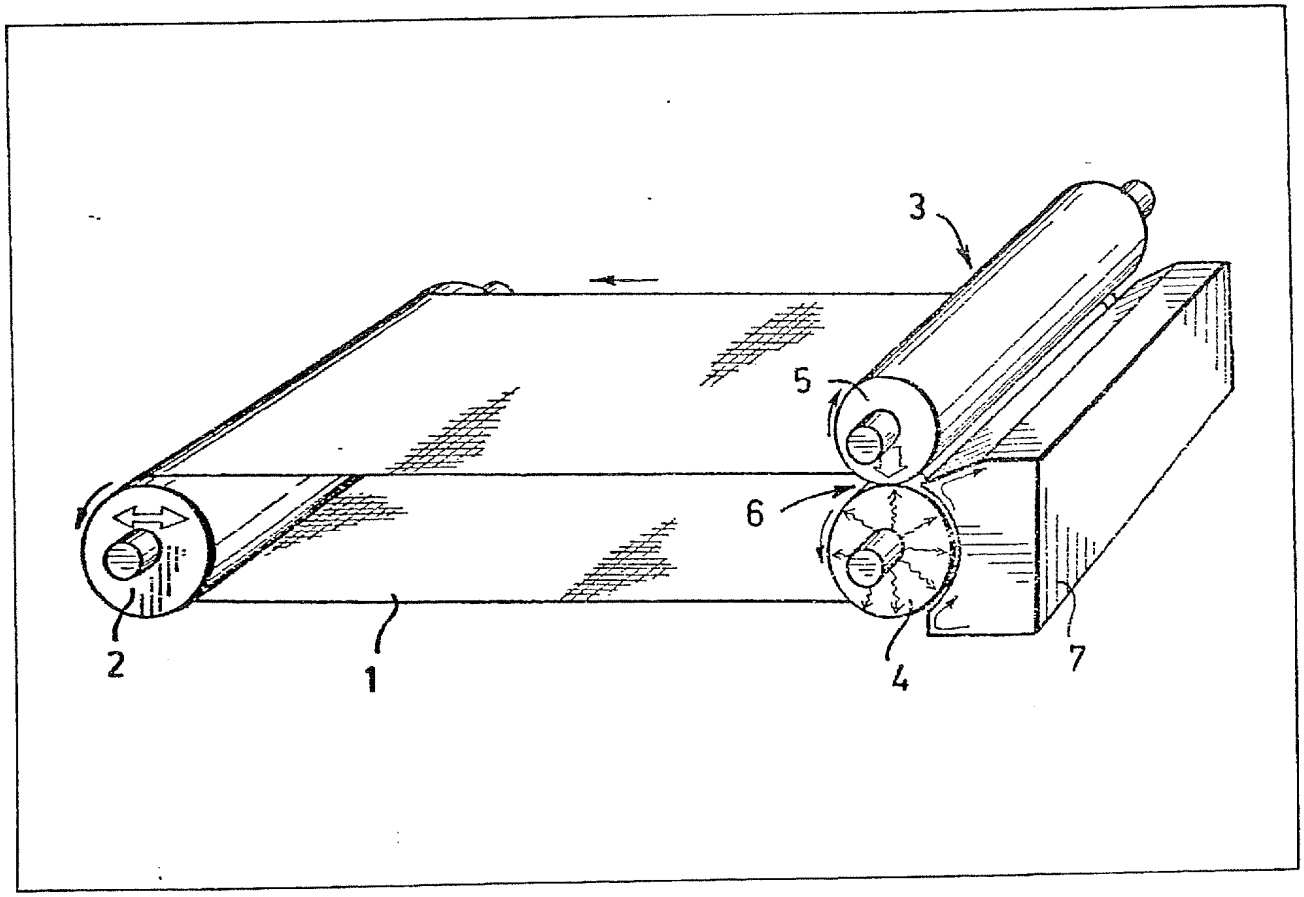
(54) Method of smoothing the surface of a felt or a wire and apparatus for carrying out said method

(57) In a method of and apparatus for smoothing the surface of an endless web, such as a felt or a wire made of thermoplastic fibres or filaments and intended to be used in paper manufacturing, the web 1 is passed through the nip 6 of a pair of press rolls comprising a press roll 5 and a heating roll 4. The web is subjected in said press nip simultaneously to a heating and pressure action for softening and compressing the web surface to face the paper, in subsequent use, in order to smooth said surface. The pressure of the roll 5 is adjustable by pressure oil to apply a uniform compressive pressure along the length of the nip 6. A tensioning roll 2 and a hot air hood 7 are provided.



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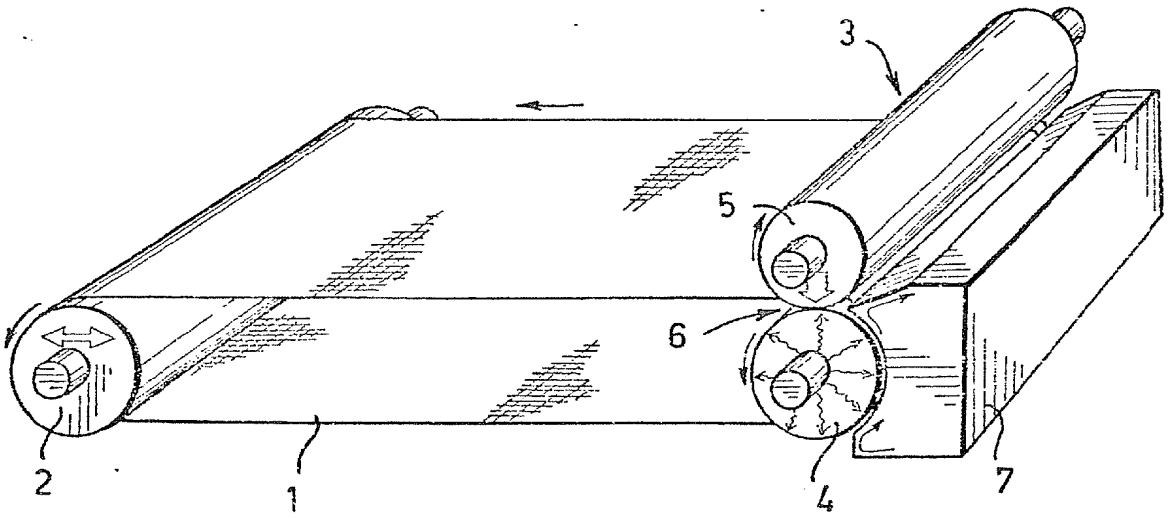

SPECIFICATION

Method of smoothing the surface of a felt or a wire and apparatus for carrying out said method

The present invention relates to a method of smoothing the surface of a felt, wire, or similar endless thermoplastic web to be used in paper manufacturing, by subjecting said web to heating and pressure for softening and compressing the web surface facing the paper.

It is previously known to finish press felts by means of so-called drying calenders, in which an endless felt is tensioned, for example, between two rolls to the desired length. One of the rolls is heated by steam or circulating oil, the felt being positioned on the rolls so that the surface of the felt facing the paper is located on the inside against the roll. While rotating around the heated roll, the surface of the felt is subjected to heating and softens. By tensioning the felt, it can be pressed against the heated roll to such an extent that the softened surface of the felt is somewhat flattened and, accordingly, becomes smoother. Because felts, due to the risk of elongation, cannot be tensioned more that 20 kp/width cm., the felt is very lightly pressed against the heated roll and the smoothing effect is small. In order to achieve a higher degree of smoothness with such a small compressive force, the felt must be subjected to a stronger heating action, whereby the heating operation will take place above the melting temperature of the fibers resulting, on the other hand, in an impaired permeability because the surface easily melts and becomes impermeable.

To achieve a greated compressive force, it has been earlier suggested to pass the felt first through a heat zone in which the felt is subjected to hot-air blowing, and thereafter through a pair of press rolls compressing the preheated felt. Out of necessity, the compressive force has been limited to the deadweight of the upper roll because an additional load causes bending of the rolls and, accordingly, an uneven compression at the edges and in the center of the felt. Also different felt widths cause an uneven compression in which case the result is also dissatisfactory. The achievement of a higher degree of smoothness would in this case require heating of the felt close to the melting temperature of the fibers which results in the above mentioned disadvantages.

The purpose of a smooth felt surface is to reduce the air quantity carried by the felt, which causes a so-called blowing effect, and renewed wetting of the felt after the compression point.

Recently, attempts have been made to provide in press felts a surface smoothness obtained by flattened fibers by using in needled surfaces preflattened fibers. Such a method, however, is not satisfactory because completely flat fibers cannot be guided so as to always be orientated in the felt with their wide surface facing the paper, and because a flat fiber, on the other hand, makes the felt too compact.

In wet wires and drying wires, the necessary surface smoothness is obtained by grinding the wire surface smooth. Owing to the fact that material is in this way removed from the filaments, the strength of the wire decreases in a corresponding degree.

In wet wires, the purpose of a smooth surface is to reduce the marking properties of the wires and, in drying wires, to achieve, among other things, a more even compression of the paper web against the drying cylinder.

It is an object of the present invention to provide a method eliminating the above mentioned disadvantages and making it possible to obtain a higher degree of smoothness and stability without reducing the permeability and the strength of the web. This object is achieved by means of a method according to the invention, which is characterized in that the web is subjected in a press nip formed by a pair of rolls simultaneously to a heating and compressing action.

The method according to the invention is based on the fact that thermoplastic fibers have a softening temperature which is lower than the melting temperature. A sufficient compressive force is applied on the web to be smoothed while the web is heated to the softening temperature. In this way, a flattening of the felt fibers and wire filaments, respectively, is achieved and also an adhesion of the fibers and filaments to each other at their crossing points. Due to the fact that the heating and compression of the web is carried out in a press formed by a pair of rolls, the compressive force can be applied on the web while it is still subjected to heating. In this way, a sufficient flattening is achieved without having to heat the web up to the melting temperature. By means of the method described, exactly those fibers and filaments are flattened which, with respect to the use, are intended to be flattened, i.e. the fibers contacting the paper web.

The adhesion of the fibers and filaments to each other at the crossing points also improves the stability of the web. Due to this, in a needled web, less needling is required, wherefore also the needle marking in the felt surface is smaller. Less needling also reduces the production costs. The hot compression glues the fibers better together than what can be achieved by means of present methods. In wet wires and drying wires, the necessary surface smoothness is obtained without reducing the strength because the cross-section of the flattened filaments remains unchanged.

The invention also relates to an apparatus for carrying out the above described method, said apparatus being characterized by a pair of rolls comprising a heating roll and a press roll forming a press nip through which the web passes.

The invention will now be described in more detail with reference to the accompanying drawing illustrating schematically an apparatus for carrying out the method according to the invention.

The drawing illustrates a needless endless press felt 1 made of thermoplastic fibers, such as polyamide, polyester or polypropylene fibers. The felt is passed around a tensioning roll 2 and a lower roll 4 of a pair of rolls 3 located at a distance from said tensioning roll. An upper roll 5 forms together with said lower roll 4 a press nip 6 through which the

felt passes. The lower roll 4 is formed as a heating roll heated by circulating oil or by electricity, the surface temperature of said roll being adjustable in the range of 20 to 260°C. The upper roll is, for example, a Küsters-type press roll, the compressive pressure of which is adjustable by means of pressure oil in a way known per se so that the compressive pressure is uniform over the entire length of the press nip across the felt. The compressive pressure can be as much as 200 kp/width cm. A hot-air hood 7 ensures the fixation of the felt.

As the felt is rotating over the heating roll 4, it is subjected to a heating action, whereby the fibers reach the softening temperature at least on the surface facing the heating roll. In the press nip 6 formed by the pair of rolls the felt is subjected to a compressive action due to which the fibers pressed against the heating roll 4 are flattened, thereby forming a smooth surface in the felt. At their crossing points, the fibers, adhere to each other inside the felt. Hereafter the felt is allowed to cool and is removed from the rolls. The treatment is substantially the same if the web to be treated, instead of a press felt, is a wet wire or a drying wire woven of filaments. The filaments pressed against the surface of the heating roll will also in this case be flattened so that a smooth surface is obtained in the wire, and the filaments, in addition, adhere to each other at their crossing points so as to produce a very stable wire.

Example

A press felt 1 measuring 7.5 x 26 m, weighing 1200 g/m² and consisting of 5 per cent wool and 95 per cent polyamide (nylon 6.6) fibers was passed as an endless web over the rolls 2 and 4. The felt was first treated in four heating steps at a speed of 5 m/min, whereby the temperature of the felt rose as follows: in the 1st step to 100°C, in the 2nd step to 160°C, in the 3rd step to 200°C, and in the 4th step to 230°C. The temperature of the circulating air in the hood was raised in step 1 to 100°C and in step 2 to 160°C to achieve a through-fixation of the felt. In steps 3 and 4, the temperature of the circulating air was not raised as the goal was to smooth the surface. A step-wise raising of the temperature is of advantage in order to produce an even felt. If the temperature is raised too much at a time, wrinkles will be formed in the felt or wire. Hereafter a pressure action of 150 kp/cm was applied on the felt during two revolutions by means of the press roll 5 while the temperature still was 230°C. The felt so treated had a very smooth surface facing the paper due to the flattening of the surface fibers and an improved stability due to the adhesion of the fibers to each other. However, the permeability of the felt was good owing to the fact that no melting of fibers occurred in the surface of the felt.

The drawing and the accompanying specification are only intended to illustrate the idea of the invention. In its details, the method and apparatus according to the invention may vary considerably within the scope of the claims.

CLAIMS

1. A method of smoothing the surface of a felt, wire, or similar endless thermoplastic web to be used in paper manufacturing, by subjecting said web to heating and pressure for softening and compressing the web surface facing the paper, characterized in that said web is subjected in a press nip formed by a pair of rolls simultaneously to a heating and pressure action.

2. A method according to Claim 1, wherein said endless web is passed around a tensioning roll and a heating roll which together with a press roll forms said press nip.

3. An apparatus for carrying out the method according to Claim 1, comprising a roll for tensioning an endless web and heating means and pressure means for heating and compressing said treatment web, characterized by a pair of rolls comprising a heating roll and a press roll forming a press nip through which said web passes.

4. An apparatus according to Claim 3, wherein said heating roll forms a second tensioning roll for said endless web, around which roll said web passes.

5. An apparatus according to Claim 3 or 4, wherein said press roll is a Küsters-type press roll.

6. A method of smoothing the surface of a felt, wire, or similar endless thermoplastic web to be used in paper manufacturing according to Claim 1 and substantially as hereinbefore described.

7. An apparatus for smoothing the surface of a felt, wire, or similar endless thermoplastic web to be used in paper manufacturing, substantially as hereinbefore described with reference to the accompanying drawing.

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